CLAIMS

We claim:

[0168] 1.**(currently amended)** A method comprising the steps of:

positioning a probe adjacent a tissue site of an animal including a human;

acquiring pre-injection data of the tissue site;

injecting a contrast agent into the animal at an injection site;

acquiring acquiring ~~data before and after injection~~ post-injection data of the tissue site;

performing a difference analysis between pre-injection data and post-injection data to detect, localize, and quantify anatomical, morphological and/or functional features of the tissue site.

[0169] 2.**(canceled)**

[0170] 3.**(canceled)**

[0171] 4.**(canceled)**

[0172] 5.**(canceled)**

[0173] 6.**(canceled)**

[0174] 7.**(canceled)**

[0175] 8.**(canceled)**

[0176] 9.**(canceled)**

[0177] 10.**(canceled)**

[0178] 11.**(canceled)**

[0179] 12.**(canceled)**

[0180] 13.**(canceled)**

[0181] 14.**(canceled)**

[0182] 15.**(canceled)**

[0183] 16.**(canceled)**

[0184] 17.**(canceled)**

[0185] 18.**(canceled)**

[0186] 19.**(canceled)**

[0187] 20.**(canceled)**

[0188] 21.**(canceled)**

[0189] 22.**(canceled)**

[0190] 23.**(canceled)**

[0191] 24.**(canceled)**

[0192] 25.**(canceled)**

[0193] 26.**(canceled)**

[0194] 27.**(canceled)**

[0195] 28.**(canceled)**

[0196] 29.**(canceled)**

[0197] 30.**(canceled)**

[0198] 31.**(canceled)**

[0199] 32.**(canceled)**

[0200] 33.**(canceled)**

[0201] 34.**(canceled)**

[0202] 35.**(canceled)**

[0203] 36.**(canceled)**

[0204] 37.**(canceled)**

[0205] 38.**(canceled)**

[0206] 39.**(canceled)**

[0207] 40.**(canceled)**

[0208] 41.**(canceled)**

[0209] 42.**(new)** The method of claim 1, further comprising the steps of:

prior to the injecting step, positioning a contrast agent delivery system adjacent the injection site.

[0210] 43.**(new)** The method of claim 1, wherein the pre-injection data comprises a pre-injection data sequence of the tissue site acquired over a pre-injection period of time.

[0211] 44.**(new)** The method of claim 1, wherein the post-injection data comprises a post-injection data sequence of the tissue site acquired over a post-injection period of time.

[0212] 45.(**new**) The method of claim 1, wherein the difference analysis is between the pre-injection data sequence and post-injection data sequence.

[0213] 46.(**new**) The method of claim 1, wherein the injection site comprises a vessel.

[0214] 47.(**new**) The method of claim 46, wherein the vessel comprises an artery supply blood to the tissue site or a vein removing blood from the tissue site.

[0215] 48.(**new**) The method of claim 46, wherein the tissue site is a vessel and the step of positioning the probe comprises the steps of:

positioning a guide-catheter in the vessel; and

positioning, on the guide-catheter, a micro-catheter including the probe in the vessel adjacent the tissue site.

[0216] 49.(**new**) The method of claim 1, further including the step of:

acquiring during injection data sequence,

wherein the performing step further includes difference analyses of the pre-injection, during-injection and post-injection data sequences.

[0217] 50.(**new**) The method of claim 1, wherein the data comprises ultrasonic data.

[0218] 51.(**new**) The method of claim 49, wherein the data comprises ultrasonic data.

[0219] 52.(**new**) The method of claim 1, wherein the pre-injection data comprises a pre-injection data sequence of the tissue site acquired over a pre-injection period of time and the post-injection data comprises a post-injection data sequence of the tissue site acquired over a post-injection period of time.

[0220] 53.(**new**) The method of claim 52, further comprising the step of:

forming pre phase-correlated data from the pre-injection data and post phase-correlated data

from the post-injection data.

[0221] 54.(**new**) The method of claim 53, further comprising the step of:

selecting a region of interest within the pre and post phase-correlated data.

[0222] 55.(**new**) The method of claim 54, further comprising the step of:

compensating for relative motion of the region of interest in the pre an post phase-correlated data.

[0223] 56.(**new**) The method of claim 55, further comprising the step of:

filtering the motion compensating pre and post phase-correlated data.

[0224] 57.(**new**) The method of claim 56, further comprising the step of:

reconstruction the filtered, motion compensated pre and post phase-correlated data.

[0225] 58.(**new**) The method of claim 57, further comprising the step of:

identifying enhancements in the region of interest as a function of a data acquisition time.

[0226] 59.(**new**) The method of claim 52, wherein the data acquisition times are from about 0.5 minutes to about 30 minutes.

[0227] 60.(**new**) The method of claim 52, wherein the pre-injection data is acquired over a pre-injection period of time ranging from about 1 second to about 10 minutes and the post-injection data is acquired over a post-injection period of time ranging from about 1 second to about 20 minutes.

[0228] 61.(**new**) The method of claim 1, wherein the data is digitized and automatically sorted and binned according to their temporal position in each of a sequence of cardiac phases over the total acquisition time.

[0229] 62.(**new**) The method of claim 1, further comprising the step of:

generating difference data or image sequences between data or frames in the pre- and post-

injection data.

[0230] 63.(**new**) The method of claim 1, further comprising the step of:

performing noise reduction on the data prior to difference analysis via mathematical averaging of temporally correlated data or frames, where temporal correlated data or images are data or images binned at a same point in a cardiac cycle.

[0231] 64.(**new**) The method of claim 1, further comprising the step of:

automatically thresholding the difference data or images to separate regions of salient grey-level enhancements.

[0232] 65.(**new**) The method of claims 64, further comprising the step of:

color-coding the thresholded difference data or images to indicate a location and strength of the enhancements.

[0233] 66.(**new**) The method of claim 1, further comprising the step of:

generating an animation of changes in enhancements over the total acquisition time of the difference data or images, thresholded data or images and/or the color-coded data or images.

[0234] 67.(**new**) The method of claim 66, wherein the animation corresponds temporally with the originally-acquired data in order to allow direct visual comparison between the original data and the processed data.

[0235] 68.(**new**) The method of claim 1, further comprising:

computing a statistical measurement of an average enhancement per enhanced pixel for each difference data or image generated over the total acquisition time to quantify numerically a presence and amount of enhancements over time.

[0236] 69.(**new**) The method of claims 68, wherein the enhancements are evidence of vasa vasorum or other structures associated with the site.

[0237] 70.(**new**) The method of claim 69, wherein the other structures include plaque, calcified plaque, malignancy structure, malignancy vascularization.

[0238] 71.(**new**) The method of claim 1, wherein the probe is selected from the group consisting of an ultrasound probe, a variable frequency ultrasound probe, a magnetic probe, a photonic probe, a near Infrared probe, a terrahertz probe, microwave probe and combinations thereof.

[0239] 72.(**new**) The method of claim 1, wherein the contrast agent is selected from the group consisting of microbubbles, magnetically active microbubbles, magnetically active nanoparticles, near Infrared visible microbubbles, near Infrared visible nanoparticles, optically visible microbubbles, optically visible nanoparticles, terrahertz visible microbubbles, terrahertz visible nanoparticles, microwave visible microbubbles, microwave visible nanoparticles, red blood, cells including magnetically active nanoparticles, near Infrared visible nanoparticles, optically visible nanoparticles, terrahertz visible nanoparticles, microwave visible nanoparticles, and mixtures thereof, and mixtures or combinations thereof.

[0240] 73.(**new**) The method of claim 1, further comprising the step of:

exposing the tissue site, after contract agent injection, to a sonic energy at a frequency sufficient to cause a position of each contrast agent to periodically change.

[0241] 74.(**new**) The method of claim 1, further comprising the step of:

exposing the site, after contract agent injection, to a sonic energy at a frequency sufficient to destroy the contrast agent.

[0242] 75.(**new**) A method comprising the steps of:

positioning a probe adjacent a tissue site of an animal including a human,

acquiring pre-altered blood flow data of the tissue site,

positioning a balloon in an artery supplying blood to or a vein removing blood from the tissue site,

altering a blood flow to the tissue site by inflating or partially inflating the balloon,

acquiring during-altered blood flow data of the tissue site,

deflating the balloon,

acquiring post-altered blood flow data of the tissue site,

performing a difference analysis between pre-altered blood flow data, during-altered blood flow data and post-altered blood flow data to detect, localize, and quantify anatomical, morphological and/or functional features of the tissue site..

[0243] 76.(**new**) The method of claim 75, wherein the inflating and deflating steps are performed periodically at a given periodicity.

[0244] 77.(**new**) The method of claim 75, wherein red blood cells act as a contrast agent.

[0245] 78.(**new**) A catheter apparatus comprising:

a guide-catheter adapted to be inserted into a peripheral vessel of an animal including a human and positioned in a target vessel; and

a contrast agent delivery system designed to inject an amount of contrast agent into the vessel.

[0246] 79.(**new**) The apparatus of claim 78, further comprising:

at least one guide-wire adapted to be extended from a distal end of the guide-catheter into the vessel; and

at least one micro-catheter having an central orifice and adapted to slide down the guide wire to a desired location in the vessel.

[0247] 80.(**new**) The apparatus of claim 79, further comprising:

a balloon adapted to augment a flow of blood in the vessel.

[0248] 81.(**new**) The apparatus of claim 79, wherein the micro-catheter includes a probe.

[0249] 82.(**new**) The apparatus of claim 79, wherein the micro-catheter includes a plurality of probes.

[0250] 83.(**new**) The apparatus of claim 79, wherein the contrast agent delivery system forms a part of the micro-catheter.

[0251] 84.(**new**) The apparatus of claim 79, wherein the contrast agent delivery system is upstream of the probe or probes.

[0252] 85.(**new**) The apparatus of claim 80, wherein the balloon is upstream of the probe .

[0253] 86.(**new**) The apparatus of claim 81, wherein the probe is selected from the group consisting of an ultrasound probe, a variable frequency ultrasound probe, a magnetic probe, a photonic probe, a near Infrared probe, a terrahertz probe, microwave probe and combinations thereof.

[0254] 87.(**new**) The apparatus of claim 78, wherein the contrast agent is selected from the group consisting of microbubbles, magnetically active microbubbles, magnetically active nanoparticles, near Infrared visible microbubbles, near Infrared visible nanoparticles, optically visible microbubbles, optically visible nanoparticles, terrahertz visible microbubbles, terrahertz visible nanoparticles, microwave visible microbubbles, microwave visible nanoparticles, red blood, cells including magnetically active nanoparticles, near Infrared visible nanoparticles, optically visible nanoparticles, terrahertz visible nanoparticles, microwave visible nanoparticles, and mixtures thereof, and mixtures or combinations thereof.